



SUBSTITUTE SPECIFICATION (CLEAN COPY)

CCELLULAR COMMUNICATIONS NETWORK AND METHOD WITH A SEARCH FUNCTION

Claim for Priority

5 This application is a national stage application under
371 of PCT/DE00/00602, filed January 3, 2000, which
claims the benefit to German Application No.
19909314.8, filed November 29, 2000.

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Technical Field of the Invention

Technology Center 2600

The invention relates to a cellular communications network with a search function and a method for same.

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Background of the Invention

Mobile radio systems that are intended for a relatively large number of subscribers are typically cellular, i.e. the total area to be served by a network is 20 divided into smaller radio cells, so-called communications cells. The smaller the individual cells are, the more mobile telephone subscribers can be supported with a limited frequency spectrum per area. The present radio-frequency digital communications 25 networks such as GSM 900 and GSM 1800 with very high subscriber numbers have small cell sizes with radii of a kilometer or less. The use of small cell sizes is also envisaged for a future UMTS mobile radio standard. It is thus possible, by assigning a mobile telephone to a 30 communications cell, to find the location the mobile telephone with a precision of a few hundred meters.

Summary of the Invention

In one embodiment of the invention, there is a 35 cellular communications system. The system includes, for example, a plurality of communications cells with at least one base station each for cordless communication with a mobile telephones; and a home location register for registration of the mobile

telephones, wherein at least one of the mobile telephones is configured to be switched to a passive mode, in which the mobile telephone detects a specific search signal for the mobile telephone, and emits a 5 response signal, the home location register has a memory to store data about mobile telephones in the passive mode, the base stations are configured to send mobile-telephone-specific search signals in the passive mode, the home location register has a control device 10 which is configured to initiate at least one search operation and determines the position or status of the mobile telephone as a result of response signals received by the base stations.

15 In another embodiment of the invention, there is a method for determining the position of a mobile telephone in a communications network. The method includes, for example, emitting a specific search signal by selected base stations; recurring the 20 response signal from the mobile telephone by one or more base stations; and determining position area where the sought mobile telephone is located as a result of the response signal.

25 In still another embodiment of the invention, there is a mobile telephone for a cellular communications network, which mobile telephone can be switched to a passive mode, in which the mobile telephone is not recognizable as a network subscriber 30 and detects a specific search signal for the mobile telephone, and sends a response signal in reply.

Brief Description of the Drawings

35 Figure 1 shows the structure of a communications system according to the invention.

Detailed Description of the Preferred Embodiments

The invention proposes a positioning system for mobile telephones for use in emergencies such as accidents or for combating crime, in which the positioning process should be possible without assistance from the mobile 5 telephone user.

The mobile telephone to be sought can be switched to a passive mode, in which it is not recognizable as a normal network subscriber. In this model, the 10 telephone receives only a specific search signal, and in answer to this emits a response signal, which is received by one or more base stations. As a result of the spatial distribution of the base stations that receive the response signal, the area in which the 15 mobile telephone is positioned can be determined.

The communications system according to the invention has the advantage that it allows a covert search for persons with a favorable cost/benefit ratio. The search 20 function can easily be integrated with software in existing or future mobile radio systems such as GSM networks and/or UMTS networks and be offered to a wide public as an additional service.

25 The invention likewise proposes a method for determining the position of a mobile telephone in a cellular communications system, and a mobile telephone for executing the search function.

The mobile telephone can be switched by a user, 30 preferably by means of an identification code (PIN), between the passive mode that allows the search function, and a normal conversation mode, and/or switched off completely. It is not possible for a user or caller to distinguish whether the mobile telephone 35 is switched off or is in the passive mode that permits the search function. A covert search is thereby enabled. The passive mode requires interaction with the network for the search operation, so that the power consumption is lower than in the normal switched-on

state with roaming, and the search function can therefore be maintained over a longer period.

5 It is also possible to switch the mobile telephone to normal operation on reception of the search signal, so that the sought person can communicate by radio with the searcher.

10 The search signal and the response signal can be encrypted, so that unauthorized persons can identify these signals only with difficulty, if at all.

15 The response signal can include encrypted information about the locality of the mobile telephone, which information is received via sensors such as a microphone affixed to the mobile telephone.

20 In order to further reduce the energy consumption in search mode, a periodic ready-to-receive state can be provided, so that the search signal is receivable for example for 10 seconds in each minute.

25 The invention is described in the following text with reference to a preferred embodiment and to the accompanying Figure 1.

Figure 1 shows the structure of a communications system according to the invention.

30 The cellular communications system has a large number of communications cells 1, each of which has a base station 2 with transceiver facility. With suitable time and/or frequency division multiplex techniques, calls can be made simultaneously in a single cell by several 35 mobile telephones 5. The cell size is between a few kilometers and a few hundred meters or less in radius, depending on the user density.

The mobile radio network has a home location register 3, in which the mobile telephones of a network operator are registered, the call acceptance and assignment are controlled and the billing is carried out.

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A mobile telephone according to the invention has, as well as the known operating states "off", in which the mobile telephone can receive no signals at all, and "on", when there is regular interaction with the 10 communications network, and so-called roaming, i.e. the present position of the mobile telephone is notified to the home location register, so that continuous availability for calls is ensured, a further operating state, referred to as the passive mode. In this mode, 15 the mobile telephone is not recognizable as a normal network subscriber, and no roaming takes place. Rather, the mobile telephone recognizes a search signal specific to itself, and sends a short encrypted response signal in reply. Neither the user who is 20 holding the mobile telephone, nor a caller can find out whether the mobile telephone is in the passive mode or switched off. The mobile telephone accessible is bringing the special search mode. The passive mode can be activated and deactivated again by the user, 25 preferably after entering an identification code (PIN).

Since, in the passive mode, there is no continuous interaction between the mobile telephone and the communications network, the mobile telephone's power 30 consumption is lower in passive mode than in the switched-on or standby operating mode. In order to reduce the power consumption further and thereby extend the operating time in the passive mode, an interval operating mode can be provided, so that the mobile 35 telephone is ready to receive the search signal for ten seconds in each minute, for example.

As soon as a mobile telephone is switched to the passive mode, this is stored in a memory 4 in the home

location register 3 together with its communications cell. No further information is subsequently available as to the cell in which the mobile telephone is located.

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The search mode can be carried out by a person with authorization for this, who proves his identity with an identification code, for example. These persons can be close relatives of the owner of the mobile telephone to 10 be found, public authorities such as police or public prosecutors, or else the employer of the mobile telephone's holder. As soon as the search process is initiated, the control device 6 linked to the home register 3 selects a number of base stations 2 for the 15 first search. For this, the information on the last whereabouts of the mobile telephone before activation of the passive mode, stored in the memory 4, is preferably consulted. The selected base stations 2 then send a specific search signal for the sought mobile 20 telephone 5. If the sought mobile telephone is within range of these base stations, it sends the encrypted response signal, which is received by one or more of the base stations. From the position of the base stations that receive the response signal, the position 25 of the sought mobile telephone can be determined relatively precisely. At the same time, the intensity and arrival time of the response signal can also be used as parameters for position finding. If the base stations receive no response signal, the search 30 operation is extended to a wider area, and repeated as necessary.

The response signal output by a mobile telephone is encrypted in duration and frequency in such a way that 35 it can be identified by a system that knows the response key. Other receivers see it as noise. Misuse of the search function can thus be avoided.

The mobile telephone can also be equipped with sensors such as a microphone or a temperature sensor. In the response signal, encrypted information about the environment of the mobile telephone in the passive mode 5 can then be transmitted, such as a noise, light/dark or the temperature, humidity or similar. These functions could be useful, for example, in finding kidnap victims.

10 A further variant of the invention is a mobile telephone for the passive mode only. It is then possible to dispense with a keyboard or display as needed for the other mobile telephone functions. The passive mobile telephone can thus be made very small 15 and light, and it does not need to have the usual form for mobile telephones. It can be included disguised in other objects such as a printer, a clock or a pocket calculator.

20 The invention enables a search function for a mobile telephone, which can easily be integrated in existing and future mobile radio communications systems. A mobile telephone in the passive mode cannot be distinguished from one that is switched off. Because 25 of the low energy consumption in the passive mode, this can be maintained over a long period.